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RED FOX POPULATION DYNAMICS IN ROMANIA: IMPLICATIONS FOR WILDLIFE MANAGEMENT

DINAMICA POPULAȚIEI DE VULPI ÎN ROMÂNIA: IMPLICAȚII PENTRU MANAGEMENTUL CINEGETIC

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ABSTRACT | REZUMAT

Wildlife management is a multipurpose tool that aims to achieve various goals sustainably, including conserving healthy populations of wild animals and their habitats while coexisting with local communities. The red fox is viewed as an invasive species, preying on valuable game and domestic animals, yet it also fulfils a crucial role in the ecosystem by carrying out phytosanitary functions. As red fox is not considered a main game species, focus on the red fox management can be neglected. This study aims to offer insight into the red fox population dynamics at the national and county levels, with an emphasis on densities and their evolution over the years. Different density categories were assessed for all counties based on the information provided by game managers to the Ministry in charge. The population dynamics were analysed for the past 25 years, showing an increasing trend. It was discovered that red fox populations in this study are below those of European countries, indicating that the population is under control in most of Romania's counties. To gain more knowledge about proper management actions, more emphasis should be placed on the red fox.

Keywords: red fox, wildlife management, small carnivore

Gestionarea faunei sălbatice este un instrument multifuncțional care urmărește gestionarea durabilă a mai multor obiective, inclusiv conservarea populațiilor speciilor de interes cinegetic și a habitatelor acestora, coexistând în același timp cu comunitățile locale. Vulpea este considerată o specie invazivă, care pradă vânatul valoros și animalele domestice, însă îndeplinește și un rol crucial în ecosistem, îndeplinind funcții fitosanitare. Deoarece vulpea nu este considerată o specie principală de vânat, concentrarea asupra gestionării vulpii poate fi adesea neglijată. Acest studiu își propune să ofere o perspectivă asupra dinamicii populației de vulpi la nivel național și județean, cu accent pe densități și evoluția acestora de-a lungul anilor. Diferitele categorii de densitate au fost evaluate pentru toate județele pe baza informațiilor furnizate de administratorii fondurilor cinegetice. Dinamica populației a fost analizată pentru ultimii 25 de ani, evidențiindu-se o tendință de creștere. S-a descoperit că populațiile de vulpi din acest studiu sunt sub cele din țările europene, indicând că populația este sub control în majoritatea județelor României. Pentru a obține mai multe cunoștințe cu privire la acțiunile de gestionare adecvate, ar trebui să se pună mai mult accent pe studierea vulpilor.

Cuvinte cheie: vulpe, management cinegetic, carnivor mic

Wildlife management can be seen as a multipurpose tool that aims to achieve multiple goals with a sustainable approach. Wildlife management primarily aims to achieve several objectives, including conserving and maintaining healthy populations of wild animals and their habitats while coexisting with local communities (11, 17, 25). The management of game species is carried out through specific measures of feeding, conservation, protection, or controlled harvesting, each of the action targeting at least one game species (19, 24).

Numerous studies have been conducted, culminating in a series of typical and differentiated proposals for species and local populations in terms of forms and modes of population management (3, 16, 18). The knowledge of game species of interest, other than those considered principal has been a constant concern in Romanian and global wildlife management.

Mostly the pressure of wildlife management falls on animals with poor conservation status, high biodiversity value or those whose economic value, can support the implementation of the management plan through controlled hunting (1, 2). Most of the time, certain game groups such as deer, are the main target for wildlife management (12), while other groups of animals, such as small carnivores, take a back seat even though their presence in the animal community is vital (9, 16).

In Romania, game species are considered a national public asset, and their management is entrusted to wildlife managers through game management units (GMU) (38). Game species are managed based on the management plan specific to each hunting ground, which involves the unified and individual management of all game species of interest. Romanian wildlife management categorises game species into main species, such as red deer, roe deer, fallow deer, wild boar, pheasant, European hare, chamois, and secondary

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species, which primarily include carnivores (38). Among these carnivores, four of them - brown bear, grey wolf, lynx, and wild cat - are strictly protected, and harvesting is forbidden due to their special conservation status (37). From the carnivores, harvesting is allowed only to certain small carnivores, notably the red fox, jackal, and specimens from the *Mustelidae* family (6).

This study is focused on the dynamics of the red fox, a species found in almost all landforms in Romania (5, 6), and globally spans approximately 70 million square kilometres, inhabiting the Northern Hemisphere from the Polar Circle to Northern Africa, Central America, the Asian steppes, and occasionally venturing into the Southern Hemisphere (4, 14).

In Romania, the red fox is the main species causing damage to small game (pheasant, partridge, European hare), occasionally large game (roe deer, fallow deer, wild boar) (6), as well as domestic species, especially poultry in the rural areas (32). This species can be considered a vector of transmission of various diseases and parasites, but the knowledge regarding this attribute of the red fox is considered understudied (15). It is acknowledged that the red fox is the primary carrier of the rabies virus, leading to national efforts to prevent its spread through specific anti-rabies vaccination programs (35). This species also fulfils a crucial role in the ecosystem by carrying out phytosanitary functions by preying on rodent species (23, 27, 29). In recent years, the species has become a problem for humans, pets, and livestock as its expansion has reached urban areas, and it is a carrier of multiple parasitic diseases (33).

The primary objective of this study is to comprehend the red fox population in Romania by determining and analysing population densities. The research is motivated by a lack of comprehensive understanding of the species' traits and the prevalent perception of its predatory behaviour.

MATERIALS AND METHODS

To evaluate the red fox density at the national level, the total area of the counties in square kilometres was taken into account using data from the National Institute of Statistics (36). Red fox population data per county were collected from the Hunting Service of the Ministry of Environment, Waters, and Forests (39), aligning with the population estimates for the 2022-2023 hunting season. These population estimates are mandatory annual assessments conducted by all hunting managers, representing a key parameter for establishing harvest quotas for the following year. By analysing these datasets, average relative densities were calculated for each county in the country. The resulting average relative densities were then categorised into six groups, ranging from I to VI (Table 1).

To evaluate the dynamics of the red fox population over the years, population estimates were obtained from the Ministry of Environment, Waters, and Forests (39) for a total of 25 hunting seasons starting in 1999.

The data was processed using Microsoft Excel, including the map development.

Table 1

Red fox density categories (county level)

Density category	Average density/1000ha
I	**0-0.99**
II	**1-1.99**
III	**2-2.99**
IV	**3-3.99**
V	**4-4.99**
VI	**5-5.99**

RESULTS AND DISCUSSIONS

Red fox density at national level

The relative density of fox populations in the country was obtained, according to the working method presented, by reporting the red fox county population to the total area of each county. For accurate data interpretation, the real densities of fox populations were further calculated by including the productive hunting areas of each county, derived from the cumulative productive areas of the hunting grounds. As a result of adjusting the areas, the following categories of real county densities were obtained:

Table 2

Red fox densities in individuals /1000 ha

County	Density	County	Density
Alba	**4.98**	Hunedoara	**3.65**
Arad	**2.98**	Ialomița	**1.53**
Argeș	**3.61**	Iași	**3.42**
Bacău	**1.44**	Ilfov	**1.98**
Bihor	**2.58**	Maramureș	**2.56**
Bistrița-Năsăud	**2.34**	Mehedinți	**2**
Botoșani	**4.28**	Mureș	**5.39**
Brăila	**4.08**	Neamț	**3.17**
Brașov	**1.13**	Olt	**1.77**
Buzău	**2.31**	Prahova	**2.96**
Călărași	**2.72**	Sălaj	**3.8**
Caraș-Severin	**4.88**	Satu Mare	**3.91**
Cluj	**0.74**	Sibiu	**3.24**
Constanța	**2.11**	Suceava	**2.62**
Covasna	**1.58**	Teleorman	**1.69**
Dâmbovița	**2.32**	Timiș	**3.67**
Dolj	**2.81**	Tulcea	**1.35**
Galați	**0.74**	Vâlcea	**3.01**
Giurgiu	**1.45**	Vaslui	**1.37**
Gorj	**1.1**	Vrancea	**1.98**
Harghita	**2.7**		

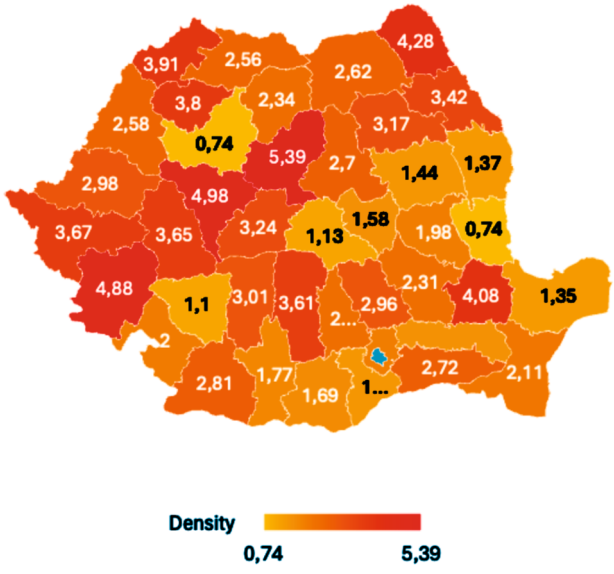

Fig. 1. Red fox density in Romania

As observed from the data presented in the previous table, the minimum densities, corresponding to density class I, are only recorded in two counties, namely Constanța and Galați, with a share of 4.83% out of the total area. Density class II is found in 12 counties, representing 25.97% of the total, while density class III is the most well-represented, present in 14 counties with a share of 34.85%. Density class IV is found in 8 counties, accounting for 21.80% of the total, and density class V is present in 4 counties, representing 9.75%. The last category, VI, is exceptionally found in only one county (Mureș), representing a low percentage of 2.82%.

Red fox population dynamics

The evolution of fox populations nationwide over the last 25 hunting seasons, from 1999 to 2023, is presented in Table 3 and graphically shown in Figure 2, based on annual figures reported at the country level by the Hunting Service of the Ministry of Environment and Forests.

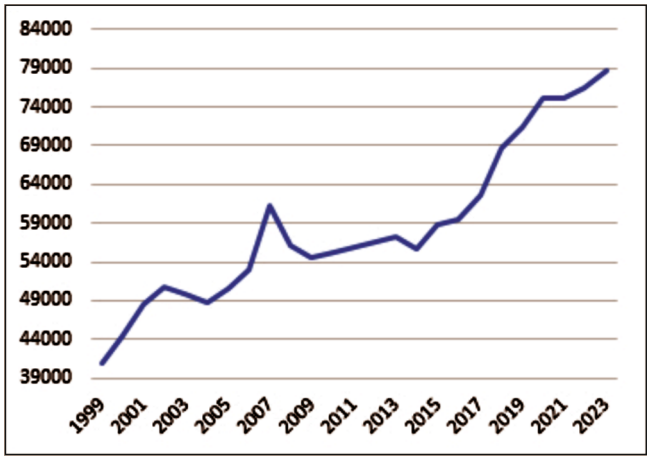

Fig. 2. Red fox population evolution

Table 3

Red fox population dynamics

Year	No.	Year	No.
1999	40956	2012	56513
2000	44430	2013	57163
2001	48607	2014	55748
2002	50735	2015	58799
2003	49889	2016	59413
2004	48778	2017	62586
2005	50468	2018	68604
2006	53102	2019	71340
2007	61258	2020	75082
2008	56031	2021	75143
2009	54667	2022	76452
2010	55213	2023	78784
2011	55863		

According to Table 3 and Figure 2, the population of red fox has seen a major increase since 1999 and almost doubled in numbers. The maximum numerical growth number is reached in 2023, with 78784 specimens, which represent an increase of 192% compared to the year 1999.

In comparison to similar studies, the red fox population density in Romania appears to be well controlled. For example, in the Bristol area of the U.K., the average density of red fox is 18.4 individuals/1000 ha, and the maximum density reaches 36.4 individuals/1000 ha (31). In Portugal, the density of red fox estimated using trap cameras was 5.4-6.9 foxes/1000 ha (28). In Sweden, the average density is around 4.0 individuals/1000 ha (7), while in Denmark (13) and East Germany (30), the abundance is around 5.0 individuals/1000 ha, respectively 5.5 individuals/1000 ha. However, lower densities can be found in North America. In Minnesota, U.S.A, a density of 2.2 individuals/1000 ha is reached (26), while in Wisconsin, a density of 0.9 individuals/1000 ha is reached (22). In Canada, a density of 1.3 individuals/ 1000 ha is reported (34).

A particular exceptional situation is noted in hunting ground no. 39 Cincu, where the real density on the productive area of the ground registers an outstanding value of over 12 specimens per 1000 ha. A possible explanation for this extreme density could be attributed to the presence of a military polygon in the area, which practically limits local hunting access and activities.

As densities increase, there is a risk that the fox will select urban areas as its habitat, where it can cause issues for residents, especially the transmission of parasitic diseases to pets and humans (10, 32). There is evidence suggesting that foxes have reduced their fear of humans, begun utilising artificial structures as shelters, and incorporated garbage and poultry into their diet (20). Through a continuous increase in fox

densities, there is a possibility of their increased incidence in peri-urban and rural areas, amplifying specific risks, as confirmed by the study (8, 21).

With the current density, it can be acknowledged that the red fox population is under control. However, the ascendant trends in fox populations at the national level may lead to imbalances within small game populations. These imbalances could result in a significant decrease in numbers or even the disappearance of certain species from specific areas (e.g., partridge, pheasant, and European hare). To maintain ecological balance, proper management actions need to be implemented as preventive measures to control the population. In regions with high population densities, an increased harvest quota should be implemented. The adjustment of harvest quota values should be supported by a technically method of determination, specifically through the existence of ecological diagnosis keys that would aid in calculating the optimal species population. These ecological diagnosis keys would be based on the synthesis of biotic, abiotic, anthropic, and hunting culture factors.

Mapping the country on fox density categories annually would indeed be a valuable future research direction. This mapping would provide insights into the evolution of red fox densities over time, enabling the identification of trends and guiding the implementation of appropriate management actions for fox populations. Extending this method to other small carnivores would be beneficial, as these species also play vital roles in ecosystems. By mapping the densities of other small carnivores, researchers can gain a comprehensive understanding of their populations, monitor changes over time, and implement targeted management strategies to ensure the conservation and balance of these species within the ecosystem.

CONCLUSIONS

The knowledge of the parameters of fox populations in the studied area has been detailed, presenting the characteristics of both static and dynamic aspects of the populations at the national, county, and study area levels. The study's analysis of red fox population dynamics in Romania has provided valuable insights into the increasing trend of red fox populations. This trend underscores the importance of wildlife management strategies to ensure the sustainable coexistence of red foxes with other species (both game and livestock) and local communities. For this purpose, a mapping of the real densities of fox populations was conducted at the county level, resulting in a significant map from this perspective. The analysis of population dynamics revealed that the populations of red foxes are experiencing an increasing trend.

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